OCAPE

The Ohio Center for Asphalt Pavement Education

Dedicated to the dissemination of knowledge leading to the development, improvement and advancement of quality asphalt pavement construction.

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Technical Bulletin: **Prime Coat Use** (2 Dec 02)

General

The necessity for using prime coat in hot mix asphalt pavement construction has long been questionable to pavement engineers. Many ideas and theories exist about when a prime coat should or should not be used. The misapplication of prime coat has in some cases created environmental concerns, and some engineers have questioned the economic benefits of prime. This technical bulletin provides information and guidance to help designers decide when prime coat can be effectively used.

What is Prime Coat?

Prime coat is the application of a penetrating liquid asphalt on a compacted aggregate base course. The liquid asphalt of choice is usually a cutback asphalt, but a cutback asphalt emulsion can be used. Regular asphalt emulsions are not suitable for prime because they do not penetrate the surface.

A cutback asphalt is asphalt cement "cut back," or diluted, with a distillate (or diluent) derived from petroleum. Cutback asphalt liquefies at a lower temperature than asphalt cement and is therefore more suitable for spraying. Medium curing cutbacks are commonly used in Ohio, but rapid curing cutbacks are also allowed. Although they take longer to cure, medium curing cutbacks are normally preferred because they are safer. Distillates used in medium curing cutbacks are kerosene, or similar material, whereas gasoline or naphtha are normally used in rapid curing cutbacks.

Upon application, the prime coat material partially penetrates and begins a curing process. The distillate evaporates and a film of asphalt cement remains covering the surface. The evaporation will depend on factors such as the kind of distillate in the cutback asphalt and the climatic conditions. High temperature, sunshine, and wind will speed the curing process, whereas low temperature and lack of sun and wind will slow the process. The time required for curing is therefore variable, and 24 to 72 hours is typical, but under best conditions at least overnight curing should take place prior to paving.

Ohio Department of Transportation construction specifications address prime coat application. Item 408 of the Construction & Material Specifications (C&MS) states that prime coats should not be applied when the surface is wet, when the atmospheric temperature is below 50 ◦F, or when the air temperature within the preceding 24 hours has been 40 ◦F or lower. However, when placing prime coats on stabilized or granular base courses, the minimum atmospheric temperature is 40 ◦F. ODOT specifications further state that the application rate should be such that the prime will be absorbed by the material within 24 hours.

Urban Legends

Some misconceptions exist concerning the use of prime coat. The first is that prime coat, when applied to an unbound granular layer, provides additional strength to the pavement. There is no denying that anytime an unbound layer of material is stabilized it is beneficiated. It is, however, an overstatement that a prime coat will result in substantially improved structural strength.

Strength contribution from prime coats is limited by the material's ability to penetrate. Uniformly graded granular surfaces – the kind typically found after the placement and compaction of crushed stone base (ODOT Item 304) – in general are very tight. This tight texture reduces porosity and consequently the penetration depth of the prime (Note: Some granular base materials are coarsely graded, thereby allowing greater penetration). Moisture in the granular base also will retard penetration. The moisture occupies the interstices of the stone where the prime needs to penetrate. The minimal amount of penetration is the reason why prime

coating does not result in a substantial change in the strength of the treated surface.

Another urban legend is that untreated bases will absorb asphalt binder from the subsequently placed asphalt layer – hence the need for a prime coat. This is false.

The viscosity of asphalt binder used in asphalt pavement construction is sufficiently high at paving temperatures that absorption by the untreated layer cannot occur. Additionally, during construction, at the interface of the granular base and the asphalt layer, the viscosity of the binder immediately increases, further reducing the opportunity for absorption. This is due to the rapid cooling of the asphalt binder as it is placed in contact with the much cooler aggregate base layer.

Environmental Considerations

Using prime coats poses some risk. Specifically, prime coat can be washed off if it has not completely cured. Runoff from treated areas yet uncured can carry the prime into a nearby ditch, stream or body of water, creating a water quality concern. Given the variable cure time for prime material, coupled with the limited ability to forecast weather, and the constraints of production schedules, properly applying prime coats is a challenge. The risks associated with prime coat use should be carefully weighed against the potential benefits.

Appropriate Uses for Prime

There are several benefits to prime coat use. Prime coats can be effectively used to protect previously placed unbound layers from traffic wear. The phasing of construction projects may require the aggregate base to be left unpaved for a while. In these instances prime coating the layer helps mitigate damage to the aggregate matrix by binding the particles.

Prime coats are also helpful when construction phasing is such that the unbound layer may be exposed to weather for an extended period of time. Priming the unbound layer will provide some weather proofing – imiting the amount of moisture into the pavement structure. Moisture infiltration, if substantial, can be detrimental to the finished pavement. Overly moist conditions in the soil subgrade will reduce its ability to sustain traffic loads, thereby reducing a pavement's serviceable life.

Some paving personnel believe that prime coats provide a benefit of limiting the amount of mix "crawl" (i.e. sliding) when placing the first layer of hot mix asphalt on the crushed aggregate base. The binder in the cured prime provides a surface to which the hot mix asphalt can adhere. Mix crawl, however, is a phenomenon that can be related to the mixture formulation. It should not be construed that the use of prime coats alone will eliminate the phenomenon.

Lastly, prime is effective for dust control. Prime, when applied to a dry surface, binds the fine aggregate particles that can be dislodged by traffic and carried away in the wind.

Conclusions

The use of prime coat must be given thoughtful consideration before it is specified for a project. The designer should weigh the potential benefits that prime coats provide against the environmental risks.

Prime coating is beneficial for binding the surface of an unbound aggregate layer – protecting the layer from degradation caused by traffic and weathering. It is also an effective measure at limiting the amount of moisture intrusion to the pavement thereby protecting the strength of the subgrade. Prime coating has been shown to be helpful in mitigating crawling of the hot mix asphalt when placed on the aggregate base. However, it should not be construed that prime coats alone can eliminate this phenomenon. Finally, prime coating is known to be an effective dust control measure.

References:

- The Asphalt Handbook, Manual Series No. 4, 1989 Edition, Asphalt Institute
- Manual of Procedures for Flexible Pavement Construction, January 1996, Ohio Department of Transportation
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